

WHAT IS CLAIMED IS:

1. A *Drosophila* cell comprising an olfactory receptor neuron containing a non-*Drosophila* odorant receptor in place of its endogenous odorant receptor(s).
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2. An *in vivo* system for determining whether a non-*Drosophila* odorant receptor binds to a test chemical, said system comprising:
 - a. a *Drosophila* cell comprising an olfactory receptor neuron containing a non-*Drosophila* odorant receptor in place of its endogenous odorant receptor(s);
 - 10 b. a test chemical;
 - c. a means of contacting the *Drosophila* cell with the test chemical; and
 - d. a means to measure the neuron response to the test chemical.
3. A method of determining whether an odorant receptor responds to a test chemical,
15 said method comprising contacting a *Drosophila* cell with the test chemical, said cell comprising an olfactory receptor neuron containing a non-*Drosophila* odorant receptor in place of its endogenous odorant receptor(s), and measuring the odor response of the neuron, thereby determining whether the odorant receptor binds the test chemical.
- 20 4. The cell of claim 1, system of claim 2, or method of claim 3, wherein the olfactory receptor neuron is a *ab3A* neuron.
5. The cell of claim 1, system of claim 2, or method of claim 3, wherein a *Drosophila* fly comprises the cell of claim 1.
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6. The cell of claim 1, system of claim 2, or method of claim 3, wherein the endogenous odorant receptors are encoded by *Or22a* and *Or22b*.
7. The cell of claim 1, system of claim 2, or method of claim 3, wherein the non-
30 *Drosophila* odorant receptor is from an insect that is a human pest or a plant pest.

8. The cell of claim 1, system of claim 2, or method of claim 3, wherein the non-Drosophila odorant receptor is isolated from an insect of the genus *Anopheles*.
9. The cell of claim 1, system of claim 2, or method of claim 3, wherein the non-Drosophila odorant receptor is encoded by *AgOr1* or *AgOr2*.
10. The cell of claim 1, system of claim 2, or method of claim 3, wherein the non-Drosophila odorant receptor is encoded by cDNA.
11. The system of claim 2 or method of claim 3, wherein the test chemical is a volatile or semi-volatile chemical.
12. The system of claim 2 or the method of claim 3, wherein the test chemical is a component of mammalian sweat.
13. The system of claim 2 or the method of claim 3, wherein the odor response is measured by single-unit electrophysiology.
14. The cell of claim 1, system of claim 2, or method of claim 3, wherein the gene encoding the non-Drosophila odorant receptor is operably linked to an *Or22a* promoter sequence.
15. The cell of claim 1, system of claim 2, or method of claim 3, wherein the gene encoding the non-Drosophila odorant receptor is operably linked to a *Gal4* sequence.
16. The cell of claim 1, system of claim 2, or method of claim 3, wherein the gene encoding the non-Drosophila odorant receptor is operably linked to a *UAS* sequence.
17. The cell of claim 1, system of claim 2, or method of claim 3, wherein the gene encoding the non-Drosophila odorant receptor is operably linked to an *Or22a* promoter sequence, a *Gal4* sequence, and a *UAS* sequence.

18. An *in vivo* system for determining whether an odorant receptor binds to at least one chemical in a test mixture of two or more chemicals, said system comprising:
- a. a *Drosophila* cell comprising an olfactory receptor neuron containing a non-*Drosophila* odorant receptor in place of its endogenous odorant receptor(s).
 - b. a test mixture comprising two or more different chemicals;
 - c. a means of contacting the *Drosophila* cell with the test mixture; and
 - d. a means to measure the odor response of the neuron.
19. A method of determining whether an odorant receptor binds to at least one chemical in a test mixture comprising two or more chemicals, said method comprising contacting a *Drosophila* cell with the test mixture, said cell comprising an olfactory receptor neuron containing a non-*Drosophila* odorant receptor in place of its endogenous odorant receptor(s); and measuring the response of the neuron, thereby determining if the odorant receptor binds to at least one chemical in the mixture.
20. The method of claim 19 further comprising testing the individual chemicals in the mixture, either individually or in various combinations, thereby determining which chemical(s) in the mixture bound with the receptor to cause neuron firing.